Contribution ID: **20** Type: **not specified**

Chiral symmetry, Conformal breaking, and transport coefficients in the two-flavour PNJL theory.

Wednesday 23 July 2025 17:45 (40 minutes)

(ONLINE)
[1] J. Wu, Y. Yin, and J. Shi, Joint simulation study of chiral symmetry recovery and transport response in QCD at finite temperature and chemical potentials, arXiv:2504.18567 [hep-ph] (2025). [2]K. Fukushima, Chiral effective model with the Polyakov loop, Phys. Lett. B 591, 277 (2004). [3]C. Ratti, M. A. Thaler, and W. Weise, Phases of QCD: Lattice thermodynamics and a field-theoretical model, Phys. Rev. D 73, 014019 (2006). [4]P. Kovtun, D. T. Son, and A. O. Starinets, Viscosity in strongly interacting quantum field theories from black hole physics, Phys. Rev. Lett. 94, 111601 (2005). [5]M. A. Stephanov, Non-Gaussian fluctuations near the QCD critical point, Phys. Rev. Lett. 102, 032301 (2009).
Abstract We develop a theoretical framework for analyzing transport phenomena in QCD matter using the two-flavor PNJL model. Within the relaxation-time approximation and Kubo formalism, we compute the shear and bulk viscosities and reveal their intrinsic connection to chiral symmetry restoration and conformal symmetry breaking. The η/s minimum tracks the vanishing quark condensate, while the ζ/s peak correlates with the trace anomaly and sound velocity suppression. These transport extrema reflect the structure of the effective potential and energy-momentum tensor correlators, providing a microscopic realization of critical dynamics in strongly interacting matter.

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Session Classification: Afternoon session 4